1. An optical compensating apparatus comprising:

a polarization controller configured to receive an optical signal propagating through an optical medium, determine the principal states of polarization of the optical medium, and transform the optical properties of the optical signal based on the principal states of polarization.

2. The apparatus of claim 1, wherein the polarization controller includes a polarimeter configured to receive and to measure the state of polarization of the optical signal, and a polarization transformer arranged in the path of the optical signal after the polarimeter and configured to transform the polarization of the optical signal.

3. The apparatus of claim 2, wherein the polarization controller further comprises a central processing unit programmed to monitor the time averaged state of polarization of the optical signal and determine the principle states of polarization of the optical medium based on the time averaged state of polarization.

4. The apparatus of claim 3, wherein the central processing unit analyzes time averaged states of polarization via the relationship, $DOP = |\vec{r}_k| = \dfrac{1-|\vec{a}|^2}{|\vec{r}_k - (\vec{a}\cdot\hat{\tau}_k)\vec{a}|}$, to determine the principle states of polarization by calculating the vector $\vec{a}$.

5. The apparatus of claim 3, wherein the central processing unit is further programmed to determine a magnitude of time delay between the principle states of polarization based on the time averaged state of polarization.

6. The apparatus of claim 3, wherein the central processing unit is further programmed to determine the relative order, in time, of the principle states of polarization.

7. The apparatus of claim 1 further comprising a delay controller arranged in an optical path of the optical signal after the polarization controller, the delay controller configured to receive the transformed optical signal and to generate a signal proportional to the PMD time delay between the principle states of polarization.

8. The apparatus of claim 7, wherein the delay controller includes a polarimeter.

9. The apparatus of claim 8, wherein the delay controller includes a delay transformer arranged in the path of the transformed optical signal before the polarimeter.

10. The apparatus of claim 1 further comprising a PMD generating module arranged in the optical path of the medium before the polarization controller and configured to receive the optical signal from the optical medium and generate a known PMD.

11. The apparatus of claim 1 further comprising a calibrating unit arranged in an optical path of the optical signal after the polarization controller, the calibrating unit configured to receive the transformed optical signal and determine the transformation of the polarization controller.

12. The apparatus of claim 11, wherein the calibrating unit includes at least one detector for detecting one or more components of the optical signal.

13. An optical compensating apparatus for reducing PMD in an optical signal transmitted through an optical medium, the apparatus comprising:

a polarization controller configured to receive an optical signal propagating through the optical medium, determine the principal states of polarization of the optical medium and a magnitude of time delay between the principal states of polarization; and

a delay controller arranged in an optical path of the medium after the polarization controller and configured to receive the transformed optical signal, wherein the polarization controller transforms the optical signal based on the principal states of polarization and the delay controller compensates PMD of the optical signal by reducing the time delay between the principle states of polarization based on the magnitude of time delay.

14. The apparatus of claim 13, wherein the polarization controller includes a polarimeter.

15. The apparatus of claim 13, wherein the delay controller is further configured to generate a signal proportional to the PMD time delay between the principle states of polarization.

16. The apparatus of claim 13, wherein the delay controller includes a polarimeter.

17. The apparatus of claim 14, wherein the polarization controller includes a polarization transformer arranged in the path of the optical signal after the polarimeter.

18. The apparatus of claim 16, wherein the delay controller includes a delay transformer arranged in the path of the transformed optical signal before the polarimeter.

19. The apparatus of claim 18, wherein the delay controller includes a delay transformer arranged in the path of the transformed optical signal after the polarimeter of the polarization controller and before a polarimeter of the delay controller.

20. An optical compensating apparatus for reducing PMD in an optical signal transmitted through an optical medium, the apparatus comprising:

a polarization module configured to receive an optical signal propagating through the optical medium, determine the principal states of polarization of the optical medium, and generate a signal for transforming the polarization of the optical signal; and

an optical transformer arranged in an optical path of the medium after the polarization module and configured to transform the optical signal and reduce a time delay between the principle states of polarization based on the signal received from the polarization module.

21. The apparatus of claim 20, wherein the polarization module comprises a polarimeter.

22. The apparatus of claim 20, wherein the optical transformer comprises a polarization transformer and a delay controller, the polarization transformer and a delay controller each comprising a polarimeter, and the polarimeter of the delay controller configured to generate a signal proportional to the PMD time delay.

23. The apparatus of claim 22, wherein the delay controller comprises a delay transformer arranged in the path of the transformed optical signal before the polarimeter of the delay controller and after the polarization transformer.

24. A method of reducing PMD of an optical signal propagating in an optical medium, the method comprising:

determining the principal state of polarizations of the optical medium with a polarization controller, and

transforming the polarization of the optical signal with a polarization transforming device based on the polarization of the first principal state of polarization.

25. The method of claim 24 further comprising determining the time delay between a first principal state of polarization and a second principal state of polarization.

26. The method of claim 25 further comprising delaying the first principal state of polarization with respect to a second principal state of polarization.

27. The method of claim 24 further comprising delaying a first principal state of polarization with respect to a second principal state of polarization.

28. The method of claim 24 further comprising determining the relative order, in time, of the principle states of polarization.

29. The method of claim 24 further comprising monitoring a time averaged state of polarization of an optical signal propagating through the optical medium.

30. The method of claim 29, wherein determining the principle states of polarization comprises analyzing the time averaged state of polarization.

31. The method of claim 30, wherein the time averaged states of polarization follow the relationship, $DOP = |\vec{r}_k| = \dfrac{1-|\vec{a}|^2}{|\vec{r}_k - (\vec{a}\cdot\hat{\tau}_k)\vec{a}|}$, and determining the principle states of polarization includes calculating the vector $\vec{a}$.

32. The method of claim 31, wherein the vector $\vec{a}$ is determined by analyzing $\vec{r}_k$ with nonlinear curve fitting techniques or matrix methods.

33. The method of claim 24 further comprising calibrating a polarization controller for transforming the optical signal to determine a plurality of control settings for the polarization controller by monitoring which control signals when applied to the polarization control transform an input optical signal having a specific state of polarization into an output signal having different state of polarization.

34. A method of compensating PMD of an optical signal propagating through an optical medium, the method comprising:

recording the time averaged state of polarization of an optical signal propagating through an optical medium; and

analyzing the time averaged state of polarization of the optical signal via a pertubative expansion of the time averaged state of polarization, $\vec{r}$, to extract a plurality of parameters from the time averaged state of polarization that characterize the PMD of the optical signal, wherein the pertubative expansion is expressed as

$$DOP^2 \equiv |\vec{r}|^2 = |\vec{S}_{0,\parallel}|^2 + (1-\Delta\omega_{pulse}^2\tau_{PMD}^2)|\vec{S}_{0,\perp}|^2 + O\{\Delta\omega^3\}.$$